| Seat |  |
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| No. |  |

S.E. (Mechanical/Auto Engineering) (I Sem.) EXAMINATION, 2019 MANUFACTURING PROCESS-I
(2015 PATTERN)
Time : Two Hours
Maximum Marks : 50
N.B. :- (i) All the questions are compulsory i.e. solve Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.
(ii) Figures to the right indicate full marks.
(iii) Assume suitable data, if necessary.
(iv) Neat diagrams must be drawn wherever necessary.

1. (a) Discuss with neat sketch Gating system used in sand casting.
(b) Describe with neat sketch the operation of wire drawing. [6] Or
2. (a) Explain Drop Forging process with neat sketch. State its advantages, limitations and applications.
(b) Cylindrical riser must be designed for sand casting mold. The size of steel casting is $60 \mathrm{~mm} \times 120 \mathrm{~mm} \times 20 \mathrm{~mm}$. The previous observation have indicated that the total
solidification time for casting is 90 sec . The cylindrical riser has $(d / h)=1$. Find the size of riser so that its total solidification time is 130 sec.
3. (a) Describe injection molding process with neat sketch. Also state its advantages, limitations and applications.
(b) Explain plasma arc welding with a neat sketch.

Or
4. (a) State any three welding defects with their causes and remedies.
[6]
(b) Explain blow moulding with suitable sketch. Discuss some applications of it.
5. (a) What is compound die ? Explain with neat sketch.
(b) Explain any three steel metal working operations with sketch.

## Or

6. (a) A cup of 60 mm diameter and 60 mm depth is to be drawn from 1.0 mm thick cold rolled steel with tensile strength of 410 MPa . The corner radius is 2 mm . Calculate the following :
(i) Size of the blank
(ii) Percentage reduction
(iii) No. of draws
(iv) Punch and die radius
(v) Die clearance
(vi) Drawing pressure.
(b) What is centre of pressure ? How is it calculated ? Explain with suitable example.
7. (a) Describe with neat sketch : Apron mechanism of lathe machine.
(b) Explain thread cutting operations performed on lathe machine with suitable sketch.

Or
8. (a) Calculate machining time for a work piece of 90 mm diameter and 130 mm length turned in 2 passes, if the approach length is 12 mm and over travel is 5 mm . Given cutting speed $=30 \mathrm{~m} / \mathrm{min}$ and feed $0.3 \mathrm{~mm} / \mathrm{rev}$.
(b) Explain taper turning attachment with neat sketch.

Total No. of Questions-8]

# SE (Mech./Auto./Sand.) (First Semester) EXAMINATION, 2019 <br> <br> THERMODYNAMICS 

 <br> <br> THERMODYNAMICS}

## (2015 PATTERN)

## Time : Two Hours

Maximum Marks :
50

1. Solve 4 questions $Q 1$ or $Q 2, Q 3$ or $Q 4, Q 5$ or $Q 6, Q 7$ or $Q 8$
2. Answer for all questions should be written in same answer book.
3. Neat Diagrams should be drawn wherever necessary.
4. Use of steam Tables and Pscychrometric chart, scientific calculator is allowed.
5. Assumes suitable marks wherever necessary.
6. Figures to the right indicate full marks.

Q1 A Draw block diagram of Heat Engine, Heat Pump and Refrigerator, write the formula for their efficiency and COP respectively ( 4 marks) also state Kelvin Plancks and Clausius statements for second law of Thermodynamics (2 marks).
B Experimental data of heat capacity of air at constant pressure is as follows, 1. Mass of air $=0.05 \mathrm{~kg}$, Air heated from 287 K to 347 K , heat input $=3012 \mathrm{~kJ}$, Adiabatic index $=1.4$. Find $a$. Specific heat of air at constant pressure ( 2 marks), b. Specific heat of air at constant volume ( 2 marks), c. Characteristic gas constant (2 marks)

OR
Q2 A Represent the constant volume process on P-v diagram for an ideal gas (1 mark) and write a real world example of constant volume process (1 mark). Derive the expression for following, for an ideal gas undergoing constant volume process (1 mark for each),
a. Heat transferred.
b. Work transferred.
c. Change in enthalpy.
d. Change in internal energy.

B A reversible heat engine operates on Carnot Cycle between source and sink temperature of 225 deg. C and 25 deg. C. If the heat engine receives 40 kW from the source, find the net work done, heat rejected to sink and efficiency of the engine.
Q3 A Derive the efficiency equation for Otto Cycle (4 marks) also show the cycle on P-v diagram (2 marks)
B Determine superheated entropy ( 2 marks), enthalpy ( 2 marks) and Specific 6 volume ( 2 marks) for a steam at 20 bar and 250 deg. C using steam table.

## OR

Q4 A With neat and labeled sketch (4 marks) explain the working of separating calorimeter for measuring dryness fraction of wet steam.
B A gas engine working on Otto Cycle has a cylinder of diameter of 0.2 m and stroke of 0.25 m . The clearance volume of $0.00157 \mathrm{~m}^{3}$. Find the air standard efficiency of Otto Cycle (assume adiabatic index gama $=1.4$ )
Q5 A Define Equivalent evaporation (3 marks) and Boiler efficiency (3 marks)
B Steam generator produces $6000 \mathrm{~kg} / \mathrm{hr}$ steam at pressure 10.5 bar with a dryness fraction of 0.9 . The feed water temperature is 49 deg . C. The amount of coal burnt is $10.83 \mathrm{~kg} / \mathrm{min}$ having CV of $30500 \mathrm{~kJ} / \mathrm{kg}$. Determine the following 1. Boiler efficiency, 2. Equivalent evaporation. OR
Q6 A Draw the heat balance sheet for boiler considering following sub components (1 mark for each component),
a. Energy credited by burning of fuel.
b. Heat transferred to boiler drum.
c. Heat transferred to economizer.
d. Heat transferred to super heater.
e. Heat transferred to air preheater.
f. Heat lost to surrounding by flue gases.

B Calculate the height of Chimney required for producing a draught equivalent to 17 mm of water. The flue gas temperature is 270 deg . C. The ambient temperature is 22 deg. C and amount of air required per kg of fuel burnt is 17 kg.
Q7 A Represent the following process on Pscychrometric chart (Draw in your answer book only) a. Sensible heating, b. Sensible cooling, c. Humidification, d. Dehumidification, e. Heating and Humidification f. Cooling and Humidification, g. Heating and Dehumidification and g. Cooling and Dehumidification.

B For air having DBT of 35 C and humidity of $10 \mathrm{gm} / \mathrm{kg}$ of dry air. Find the following and mention correct units ( 1 mark each for following),

1. Enthalpy of air.
2. WBT.
3. DPT.
4. Relative humidity.
5. Specific humidity.
(Show the point on Pscychrometric chart (2 marks))
OR
Q8 A Define the following terms related to Pscychrometry (any 6),
6. DBT.
7. WBT.
8. DPT.
9. Humidity.
10. Degree of Saturation.
11. Relative humidity.
12. Specific humidity.

B Moist air of mass flow rate $200 \mathrm{~m}^{3} / \mathrm{min}$ at 15 deg. CDBT and $75 \% \mathrm{RH}$ is sensibly heated until its temperature reaches 25 deg . C. Find a. Enthalpy of air at inlet ( 1 marks), b. Enthalpy of air at exit (1 marks), c. Mass flow rate of air (2 marks) and d. Heat added to the air in KW (1 marks). Show the process on Pscychrometric chart ( 2 marks).

## Seat <br> No.

[5559]-113

## S.E. (Mechanical/Auto.) (First Semester) EXAMINATION, 2019 MATERIAL SCIENCE

(2015 PATTERN)
Time : 2 Hours
Maximum Marks : 50
N.B. :- (i) Answer four question : Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.
(ii) Neat diagrams should must be drawn wherever necessary.
(iii) Use of non-programmable electronic pocket calculator is allowed.
(iv) Figures to the right indicate full marks.
Q. 1 a) Classify and describe different types of polymers on the basis of molecular structure and comment on their mechanical properties
b) Compare metals, ceramics and polymers on the basis of atomic bonding, atomic arrangement and properties.
c) Explain in brief with neat sketch line defects in crystal structures.

OR
Q. 2 a) What is work hardening? Explain single crystal and dislocation theory of work hardening.
b) Derive an expression for resolved shear stress across slip plane in a single crystal subjected to tensile load(P). Slip plane is oriented at an angle of " $\varnothing$ " between normal to slip plane and direction of loading and angle of " $\kappa$ " between direction of loading and slip plane in the slip direction. State Schmids law.
c) Calculate planar atomic density of (100) plane in FCC, assume lattice parameter as 'a'. Also calculate linear atomic density of [011] direction in this plane.
Q. 3 a) State working principle and operational steps of dye penetrant test for detection of surface cracks.
b) Differentiate between true stress-strain and engineering stress-strain.
c) Explain the mechanism of dry corrosion and factors affecting dry corrosion.

OR
Q. 4 a) State various methods of prevention of corrosion and explain any one in detail.
b) State true or false and justify your answer. (Full marks for correct justification only)
i) Pitting is the most dangerous form of corrosion.
ii) In anodic protection method for corrosion metal to be protected is forced to behave as cathode.
c) What is fatigue? Draw S-N diagram for ferrous and nonferrous materials. Define the term fatigue limit and fatigue strength.
Q. 5 a) Explain the principle and working of electroplating with neat diagram. Which factors affect the quality of coating in electroplating?
b) Why surface preparation is essential before coating? List various methods of surface preparation and explain any one in detail.
c) Explain in brief different defects observed in coatings.

OR
Q. 6 a) How surface modification methods are classified? List at least any two methods in each category and explain any one in brief.
b) Explain with neat diagram PVD process of coating and state its advantages, limitations and applications.
c) Explain in brief with neat diagram lon implantation.
Q. 7 a) Explain the need and mechanism of sintering in powder metallurgy component. What is liquid phase sintering?
b) State various mechanical methods of powder manufacturing and explain in brief atomization.
c) Explain with neat flow chart manufacturing of self-lubricated bearings.
Q. 8 a) What do you understand by powder characterization? Explain in brief any two methods of particle size measurement.
b) Explain with neat flow chart manufacturing of cemented carbide tools.
c) State the advantages, limitations and applications of powder metallurgy.

Total No. of Questions-8]
[Total No. of Printed Pages-3
[5559]-114

## S.E. (Mech./Autom.) (Second Semester) EXAMINATION, 2019 FLUID MECHANICS <br> (2015 PATTERN)

## Time : 2 Hours

Maximum Marks : 50
N.B. :- (i) Neat diagrams must be drawn wherever ncessary.
(ii) Figures to the right indicate full marks.
(iii) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(iv) Assume suitable data, if necessary.

Q1) a) Derive an expression for total pressure and center of pressure for inclined plane submerged in liquid and hence derive the expression for center of pressure for vertical plane.
b) The stream function for flow is given as $\psi=6 x-4 y+7 x y+9$. Is the flow is rotational? Also find its velocity potential function.

OR
Q2) a) Discuss various type of flows with examples
b) A vertical gap 1.2 cm wide of infinite extent contains a fluid of viscosity 10 Poise and specific gravity 0.9 . A metallic plate $1 \mathrm{~m} * 1 \mathrm{~m} * 0.2 \mathrm{~cm}$ is to be lifted up with a constant velocity of $0.2 \mathrm{~m} / \mathrm{s}$, through the gap. If the plate is in the middle of the gap, find the vertical force required. The weight of the plate is 50 N

Q3) a) A $300 \mathrm{~mm} \times 150 \mathrm{~mm}$ venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9 , flow being upward. The difference in
elevation.of the throat section and entrance section of the venturimeter is 300 mm . The differential U-tube mercury manometer shows a gauge deflection of 250 mm . Calculate:
i)The discharge of oil, and
ii)The pressure difference between the entrance section and the throat section.

Take $\mathrm{Cd}=0.98$ and specific gravity of mercury as 13.6 .
b) Derive an expression of velocity and shear stress distribution for laminar flow between fixed parallel plates.

## OR

Q4) a) Define HGL and TEL. Draw a neat diagram of venturimeter and show HGL and TEL for it.
[6]
b) A 0.2 m diameter pipe carries liquid in laminar region. A Pitot tube placed in the flow at a radial distance of 6 cm from the axis of the pipe indicates velocity of $0.5 \mathrm{~m} / \mathrm{s}$. Calculate: The maximum velocity, mean velocity and discharge in the pipe.

Q5) a) A pipe of diameter 25 cm and length 2000 m connects two reservoirs, having difference of water level 25 m . Determine the discharge through the pipe. If an additional pipe of diameter 25 cm and length 1000 m is attached to the last 1000 m length of existing pipe find the increase in discharge. Neglecting minor losses. Take coefficient of friction $=0.015$
b) Explain the concept of series of pipe, parallel pipe and equivalent pipe with figure

## OR

Q6) a) Derive on the basis of dimensionless analysis suitable parameters to present thrust developed by a propeller .Assume that the thrust $T$ depends upon angular velocity $\omega$, speed of advance $V$, diameter D , viscosity $\mu$, density $\rho$ and speed of sound $C$.
(b) Explain:

1) Reynolds Number
2) Froude Number

Q7) a) A jet plane which weighs 19.62 KN has a wing area of $25 \mathrm{~m}^{2}$.it is flying at a speed of 200 km per hour. When the engine develops $588600 \mathrm{~W}, 70 \%$ of this power is used to overcome the drag resistance of the wing. Calculate the coefficient of drag and lift for the wing .if density of air is $0.00125 \mathrm{gm} / \mathrm{cc}$. [7]
(b) Explain: 1) terminal velocity 2) skin friction drag 3) pressure drag
OR

Q8) a) Explain the concept of separation of boundary layer. What are the methods of preventing the separation of boundary layer
(b) Find the displacement thickness, momentum thickness and energy thickness for velocity distribution in the boundary layer by $\left\{\frac{u}{U}=\frac{\mathrm{y}}{\delta}\right\}$, where u is the velocity at a distance y from the plate and $\mathrm{u}=\mathrm{U}$ at $\mathrm{y}=\delta$, where $\delta=$ boundary layer thickness. Also calculate the value of $\delta^{*} / \Theta$.

Total No. of Questions-8]
[Total No. of Printed Pages- $\mathbf{3}$

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[5559]-115

## S.E. (Mech./Autom.) (Second Semester) EXAMINATION, 2019 THEORY OF MACHINES-I

## (2015 PATTERN)

## Time : 2 Hours

Maximum Marks :
50

## tructions to the candidates:

1) Answer Q1or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
2) Neat diagrams must be drawn wherever necessary.
3) Figures to the right side indicate full marks.
4) Use of Calculator is allowed.
5) Assume Suitable data if necessary.

1 a) What do you understand by inversion of a kinematic chain? Explain with the help of neat sketches any one inversion of a double slider crank chain, giving their practical applications.
b) Redraw the mechanism as shown in fig. and determine types and number of pairs, links and degree of freedom.


OR
.2 a) With the help of neat schematic diagram derive frequency equation of Bifilar suspension method.
b) A connecting rod of petrol engine has mass of 2 Kg and the distance between the centre of gudgeon pin and centre of crank pin is 250 mm . the C. G. falls at a point 100 mm from the crank pin centre. The radius of gyration about an axis through C. G. perpendicular to the plane of rotation is 110 mm . Find the equivalent kinetically system if one of the mass is located at the gudgeon pin.

## .3 a) Explain construction and working of Tatham Dynamometer with neat sketch.

b) A conical friction clutch is used to transmit 90 kW at 1500 r.p.m. The semi-cone angle is $20^{\circ}$ and the coefficient of friction is 0.2 . If the mean diameter of the bearing surface is 375 mm and the intensity of normal pressure is not to exceed $0.25 \mathrm{~N} / \mathrm{mm} 2$, find the dimensions of the conical bearing surface and the axial load required.

## OR

Q. 4 a) For an I.C. engine mechanism, the crank radius is 90 mm and connecting rod length is 450 mm . The crank is rotating in clockwise direction with angular velocity of $15 \mathrm{rad} /$ sec . and the angular acceleration of $100 \mathrm{rad} / \mathrm{sec}^{2}$. Using complex number method, find the acceleration of the piston and angular acceleration of the connecting rod when the crank is at $60^{\circ}$ from the inner dead centre.
b) A single hook's joint is to connect two shaft. The driving shaft operates at a uniform speed of 1500 rpm . Find the greatest permissible angle between the shafts so that fluctuation of shaft may not exceed 200 rpm . Also find maximum and minimum speed of output shaft.
Q. 5 a) Explain with neat sketch; 1. Space centrode, 2. Body centrode.
b) A Four-bar mechanism with ternary link is shown in fig. The link lengths are $\mathrm{O}_{1} \mathrm{O}_{2}=$ $600 \mathrm{~mm}, \mathrm{O}_{1} \mathrm{~A}=300 \mathrm{~mm}, \mathrm{AB}=400 \mathrm{~mm}, \mathrm{O}_{2} \mathrm{~B}=450 \mathrm{~mm}, \mathrm{AC}=300 \mathrm{~mm}$. Determine velocity \& acceleration of coupler $A B$. Using relative velocity method, when angular velocity of link $O_{1} \mathrm{~A}=20 \mathrm{rad} / \mathrm{s}$ \& angular acceleration of link $\mathrm{O}_{1} \mathrm{~A}=100 \mathrm{rad} / \mathrm{S}^{2}$ $l(\mathrm{BC})=200 \mathrm{~mm}$

Q. 6 a) Explain with the help of neat sketch velocity image principal.
b) Following figure shows a mechanism in which the driving crank OA rotates in the clockwise direction at a constant speed of 225 rpm . Link AB drives the link CD through a pin joint at B. Block $C$ is free to slide in a fixed curved slot, the center of which is at $\mathrm{O}_{\mathrm{I}}$. Determine for the configuration shown the magnitude and direction of (i) velocity of slider $D$, (ii) angular velocity of $A B$

Q.7.a) Explain construction of velocity polygon by using Kleins construction when the crank rotates with uniform angular velocity.
b) A quick return mechanism is shown in fig. Link OA rotates at $20 \mathrm{rad} / \mathrm{s}$. Draw the velocity and acceleration diagram using relative velocity and acceleration method. Link lengths are $\mathrm{OA}=150 \mathrm{~mm}, \mathrm{BC}=250 \mathrm{~mm} \& \mathrm{OC}=350 \mathrm{~mm}$. Find angular velocity of link $B C$ and Coriolis acceleration.

Q. 8 a) Explain the procedure to decide direction of coriolis component of acceleration with neat sketch.
b) The following data relate to a slider crank mechanism. Crank radius $=150 \mathrm{~mm}$, connecting rod length $=650 \mathrm{~mm}$, crankshaft speed $=240 \mathrm{~mm}$. Find the following at the instant when the slider has zero acceleration by using Klein's construction, the velocity \& acceleration of the mid - point of connecting rod.
c) The crank of reciprocating engine is 180 mm long, the connecting rod is 720 mm long. When the crank has turned through $40^{\circ}$ from inner dead centre, it has an instantaneous speed of 300 rpm clockwise, increasing at the rate of $120 \mathrm{rad} / \mathrm{s}^{2}$. Find the following using Klein's construction, The velocity and acceleration of piston.

Total No. of Questions-8]
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[5559]-116

## S.E. (Mechanical and Automobile Engineering) (Second Semester) EXAMINATION, 2019 <br> ENGINEERING METALLURGY <br> (2015 PATTERN)

## Time : 2 Hours

Maximum Marks : 50
Please read the following instruction carefully:

1. Answer four questions: Q.No. 1 or Q.No.2, Q.No. 3 or Q.No.4, Q.No. 5 or Q.No.6, Q.No. 7 or Q.No. 8
2. Neat diagram should be drawn wherever necessary
3. Use of non programmable electronic pocket calculator is allowed
4. Figures to the right indicate full marks. (Marks in square bracket are maximum marks.)

| 1 | a | Explain with the help of neat. well labelled sketch. the term <br> 'Dendrite'. | $[4]$ marks |
| :--- | :--- | :--- | :--- |
|  | b | Differentiate between solid solution and intermetallic <br> compound. | $[4]$ marks |
|  | c | What are the variables that determine the microstructure of an <br> alloy? | $[4]$ marks |
| 2 | a | Define the following terms OR <br> a) Eutectectic Transformation <br> b) Grain <br> c)Solvus line. <br> d) Deoxidation: <br> b <br> cWhat is a spark test? What is its use? |  |
| List the steps in process used to prepare a metallographic <br> sample for observation under optical microscope. | [4] marks |  |  |


| 3 | a | As the tempering temperature of a hardenend component is <br> increased, the hardness of the component decreases, Explain <br> why the hardness of the component decreases with <br> temperature? | $[4]$ marks |
| :--- | :--- | :--- | :--- |
|  | b | Draw neat diagram of microstructures and indicate phases <br> present and their amounts in the following plain carbon steels <br> under equilibrium conditions: <br> i. $0.4 \%$ carbon steel <br> ii. $\quad 1.2 \%$ carbon steel: | $[4]$ marks |
|  | c | Rank the following iron-carbon alloys and associated <br> microstructures from the highest to the lowest tensile <br> strength: | [4]marks |


|  |  | (a) $0.25 \mathrm{wt} \% \mathrm{C}$ with spheroidite <br> (b) $0.25 \mathrm{wt} \% \mathrm{C}$ with coarse pearlite <br> (c) $0.60 \mathrm{wt} \% \mathrm{C}$ with fine pearlite <br> (d) $0.60 \mathrm{wt} \% \mathrm{C}$ with coarse pearlite Justify your answer |  |
| :---: | :---: | :---: | :---: |
|  |  | OR |  |
| 4 | a | Sketch and label microstructure of the following steels - <br> i. Hypoeutectoid steel <br> ii. Eutectoid steel | [4]marks |
|  | b | State two advantages of alloy steels over plain carbon steel and two advantages of plain carbon steel over alloy steel | [4]marks |
|  | c | What is martempering? What are the advantages of martempering over conventional hardening? | [4]marks |
| 5 | a | Explain why thicker sections are more susceptible to cracking during hardening heat treatment. Which heat treatment will you recommend to prevent cracking? | [5] marks: |
|  | b | Mention the names of alloying elements used and percent of alloy used in the following steels- <br> 1. T 70 <br> 2. - XT75W18Cr4V1 | [4]marks |
|  | c | Give two major differences between martensitic and pearlitic transformations. | [4]marks |
|  |  | OR |  |
| 6 | a | What influence does Molybdenum (Mo) addition have on steel? Why is Mo used as an alloying element? | [5]marks |
|  | b | What is stainless steel? Why are these steeis stainless? | [4]marks |


|  | c | Mention the names of alloying elements used and the amount <br> in percent of alloy used in the following steels- <br> 1. C40 <br> 2. AISI 1040 | $[4]$ marks |
| :--- | :--- | :--- | :--- |
| 7 | a | Differentiate between ferrous and on ferrous metals and <br> alloys. Give examples of each. | [5]marks |
|  | b | Why is it not advisable to repair by welding a structure made <br> of non heat treatable Aluminium alloy? | $[4]$ marks |
|  | c | What is the difference between natural and arlificial aging <br> process of a precipitation hardening alloy? | [4]marks |
| 8 | a | What is precipitation hardening? Explain how the hardness of <br> Aluminium-4.5\% copper alloy can be increased by <br> precipitation hardening? Illustrate with sketch. | [5]marks |
|  | b | What is season cracking of brasses? How can it be avoided? | [4]marks |
|  | c | Which alloy is used for soldering of electronic components? <br> Why? | [4]marks |


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## S.E. (Mech./Autom.) (Second Semester) EXAMINATION, 2019 APPLIED THERMODYNAMICS (2015 PATTERN)

## Time : 2 Hours

Maximum Marks :

## Instructions:

i. Answer Q1or Q2, Q3or Q4, Q5 or Q6, Q7 or Q8
ii. Neat diagrams must be drawn wherever necessary.
iii. Figures to the right side indicate full marks.
iv. Assume Suitable data if necessary.
v. Use of scientific calculators is allowed.

Q1. a) Draw the actual valve timing diagram of 4 -stroke S. I. Engine and answer the following:
i) Why does inlet valve close some degrees after BDC
ii) Why does exhaust valve open some degrees before BDC
b) Draw the schematic diagram of M.P.F.I. system. List down the any four sensors, explain their location and function.

## OR

Q2. a) Explain the following for an actual S.I. Engine cycle:
(i) Effect of spark timing on time loss
(ii) Effect of exhaust valve opening on exhaust blowdown loss

Draw the actual $\mathrm{p}-\mathrm{V}$ diagrams to support your answer.
b) Compare the effect of engine rpm, turbulence and compression ratio on the $1^{\text {st }}$ and $2^{\text {nd }}$ stage of combustion of S.I. engine in terms of crank angle and milliseconds.
Q3. a) With neat sketch explain the construction and working of Compression Swirl type Combustion Chamber in C.I. Engine.
b) A single cylinder 4-stroke Engine gave the following results on full load.

Area of indicator card $=300 \mathrm{~mm} 2$, Length of diagram $=40 \mathrm{~mm}$, Spring constant $=1 \mathrm{bar} / \mathrm{mm}$, speed of engine $=400 \mathrm{rpm}$, load on brake $=370 \mathrm{~N}$, spring balance reading $=50 \mathrm{~N}$, Diameter of brake drum $=1.2 \mathrm{~m}$, fuel consumption $=2.8 \mathrm{~kg} / \mathrm{h}, \mathrm{C} . \mathrm{V}$. Of fuel $=41800 \mathrm{~kJ} / \mathrm{kg}$, diameter of cylinder $=160 \mathrm{~mm}$, Stroke of piston $=200 \mathrm{~mm}$.
Calculate: i) Indicated MEP ii) Indicated thermal efficiency iii) Brake power iv) Brake Thermal Efficiency.

## OR

Q4. a) Explain in detail the effects of following variables on the 1 'st combustion stage of C.I.
Compression ratio, injection advance angle, engine speed, supercharging, initial air temperature and engine rpm.
b) A gasoline engine working on four stroke develops a brake power of 20.9 KW . A Morse test was conducted on this engine $\&$ the brake power obtained when each cylinder was made inoperative by short circuiting the spark plug are $14.9,14.3,14.8 \& 14.5$ respectively. The test was conducted at constant speed of 3000 rpm . Find the indicated power, mechanical efficiency \& bmep when all cylinders are firing. The bore of the engine is 75 $\mathrm{mm} \&$ the stroke is 90 mm .

Q5. a) Explain the variation of $\mathrm{HC}, \mathrm{CO}$ and NOx emission with respect to air fuel ratio for S.I. engine.
b) Explain the construction and working of Transistor assisted Contact type ignition system with circuit diagram. How does it overcome the drawbacks of conventional ignition system? OR
Q6. a) How does Positive Crankcase Ventilation system reduce the pollution due to crankcase Blow-by? Explain with diagram.
b) Explain pressurized Cooling system with diagram and state its advantages over conventional cooling system.

Q7. a) Derive the expression for ideal intermediate pressure for two stage single acting reciprocating air compressor working under perfect intercooling condition. What is its effect on discharge temperature, pressure ratio and work required for each stage?
b) A two stage air compressor with perfect intercooling takes in air at 1 bar and $27^{\circ} \mathrm{C}$. The law of compression in both the stages is $p v^{1.3}=$ constant. The compressed air is delivered at 9 bar from the H.P. cylinder to an air receiver. Calculate, per kg of air, (a) minimum work of compression, (b) heat rejected in intercooler, (c) work required for single stage compression to the same delivery pressure.

OR
Q8. a) What is the difference between Fan, Blower and compressor? Explain Root's blower with neat sketch.
b) A two stage single reciprocating air compressor, takes in air 1 bar and $20^{\circ} \mathrm{C}$. It discharges air at 40 bar. The temperature rise in inter-cooler is $22^{\circ} \mathrm{C}$. Assume polytropic compression and expansion with $n=1.33$, perfect inter-cooling with ideal intermediate pressure and calculate (a)Work of compression. (b) \% saving in work of compression as compared to single stage. (c) Mass of cooling water required in the inter-cooler per kg of air. Assume $\mathrm{Cp}=1.005 \mathrm{kj} / \mathrm{kg}$ for air and $4.187 \mathrm{kj} / \mathrm{kg}$ for water.

| Seat <br> No. |  |
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[5559]-118
S.E. (Mechanical/Automobile/Mech. S/W)
(I Sem.) EXAMINATION, 2019

## STRENGTH OF MATERIALS

(2015 PATTERN)
Time : Two Hours
Maximum Marks : 50
N.B. :- (i) Solve Q. 1 or 2 , Q .3 or 4, Q. 5 or 6, Q. 7 or 8.
(ii) Neat diagrams must be drawn wherever necessary.
(iii) Figures to right indicate full marks.
(iv) Use of Electronic pocket calculator is allowed
(v) Assume suitable data if necessary

1. (a) A homogeneous bar with a cross sectional area of $500 \mathrm{~mm}^{2}$ is attached to rigid supports. It carries the axial loads $\mathrm{P} 1=25 \mathrm{kN}$ and $\mathrm{P} 2=50 \mathrm{kN}$, applied as shown in Fig.1. Determine the stress in segment BC and CD


Fig. 1
(b) A beam AB 8 meters long has supports at its ends A and B. It carries a point load of 10 kN at 2.5 meters from A and a point load of 7 kN at 7 meters from A and a uniformly distributed load of 2 kN per meter between the point loads. Draw SF and BM diagrams for the beam.

OR
2. (a) The bulk modulus of material is 50 GPa . A 12 mm diameter rod of material was subjected to axial load of 14 KN and the change in diameter was observed 0.0036 mm . Calculate Poisson's ratio and modulus of eiasticity for material.
(b) Fig 2 shows SFD. Draw loading diagram and BMD. Also find point of contraflexure if any


Fig2
3. (a) Find deflection at point B and C of cantilever beam shown in fig.3. Cross section of beam is $150 \times 250 \mathrm{~mm}$ and take $\mathrm{E}=200 \mathrm{GPa}$.


Fig3
(b) Cross section of beam is shown in fig.4. Calculate central point load that SSB of span of 4 m can carry if permissible stresses in bending are 120 MPa in compression and 40 Mpa in tension. Take $\mathrm{I}_{\mathrm{NA}}=425.17 \times 10^{6} \mathrm{~mm}^{4}$


## OR

4. (a) A steel section. as shown. in Fig. 5 is subjected to a shear force of 15 KN . Determine the shear stress at key points and sketch the shear stress distribution diagram [6M]


Fig. 5
(b) A load of 100 N falls through height of 2 cm on a collar rigidly attached to lower end of vertical bar 1.5 m long and cross section of bar is rectangular $15 \times 10 \mathrm{~mm}$. The upper end of vertical bar is fixed. Determine Maximum instantaneous stress developed in vertical bar and strain energy stored in vertical bar.
Take $\mathrm{E}=200 \mathrm{GPa}$
5. (a) A solid shaft of 180 mm diameter has the same cross-sectional area as that of hollow shaft of the same materials of inside diameter 130 mm . Find out the ratio of power transmitted by the two shafts for same angular velocity. Consider shear stress developed in both shafts is same.
(b) Compare the crippling load given by Euler's and Rankine's formula for a tubular steel strut 2.3 m long having external diameter 38 mm and internal diameter 33 mm . Strut is fixed at one end and hinged at other end. Yield stress for steel 335 $\mathrm{MPa}, \mathrm{E}=205 \mathrm{GPa}, \mathrm{a}=1 / 7500$

OR
6. (a) For a hollow steel shaft shown in fig6. applied torque is 2400 N -m. Length of shaft is 500 mm , outer diameter $\mathrm{D}_{2}$ is 50 mm and inner diameter is $D_{1}$ is 40 mm . Determine maximum and minimum shear stress in the shaft and angle of twist at free end. Take modulus of rigidity 77 GPa


Fig 6
(b) Determine the buckling load for a strut of tee section, the flange width being 100 mm , overall depth 80 mm and both flange and web 10 mm thick. The strut is 3 m long and is hinged at both ends. Take $\mathrm{E}=200 \mathrm{GN} / \mathrm{m}^{2}$ thick by using Euler formulae.
7. (a) A plane element is subjected to stresses as shown in fig.7. Determine principal stresses, maximum shear stress and normal stress on plane inclined at $45^{\circ}$ as shown in fig. using Mohr's circle


Fig 7
(b) An axial pull of 20 kN along with a shear force of 15 kN is applied to a circular bar. The elastic limit of the bar material is 230 MPa , factor of safety is 2 and the Poisson's ration, $\mu=0.3$. Determine the diameter of circular bar based on
i) Maximum shear stress theory
ii) Maximum principal stress theory

## OR

8. (a) A point in strained material is subjected to stresses as shown in fig.8. Find principal stresses, maximum shear stress and positions of principal plane


Fig8
(b) At a section of mild steel shaft of diameter 180 mm , the maximum torque is $\mathbf{6 7 . 5}$ $\mathrm{KN}-\mathrm{m}$ and maximum bending moment is $40 \mathrm{KN}-\mathrm{m}$. Determine whether the failure of material will occur or not according to maximum shear stress theory. If not, then find factor of safety. Take $\sigma_{y}=220 \mathrm{~N} / \mathrm{mm}^{2}$
[6M]

| Seat <br> No. |  |
| :--- | :--- |

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# S.E. (Mech/Auto./S/W) (I Sem.) EXAMINATION, 2019 ENGINEERING MATHEMATICS-III 

(2015 PATTERN)
Time : Two Hours
Maximum Marks : 50
N.B. :- (i) Neat diagrams must be drawn wherever necessary.
(ii) Figures to the right indicate full marks.
(iii) Use of electronic pocket calculator is allowed.
(iv) Assume suitable data, if necessary.

1. (a) Solve any two of the following differential equations :
(i) $\frac{d^{2} y}{d x^{2}}+6 \frac{d y}{d x}+9 y=e^{-3 x} \cos 4 x+6 e^{2 x}$
(ii) $\quad x^{2} \frac{d^{2} y}{d x^{2}}+x \frac{d y}{d x}+16 y=x^{2}+2^{\log x}+4 \cosh (\log x)$
(iii) $\frac{d^{2} y}{d x^{2}}+y=\operatorname{cosec} x$, (by using method of variation of parameters)
(b) Solve the integral equation :

$$
\int_{0}^{\infty} f(x) \cos \lambda x d x=e^{-2 \lambda}, \lambda>0
$$

2. (a) A 8 lb weight is placed at one end of a spring suspended from the ceiling. The weight is raised to 5 inches above the equilibrium position and left free. Assuming the spring cosntant $12 \mathrm{lb} / \mathrm{ft}$, find the equation of motion, the displacement function, amplitude and period.
(b) Solve any one of the following :
(i) $\mathrm{L}\left[t e t^{2 t} \cos 3 \mathrm{t}\right]$
(ii) $\mathrm{L}^{-1}\left[\frac{2 s+7}{s^{2}+4 s+29}\right]$.
(c) Solve the differential equation by Laplace transform method : [4]

$$
\frac{d^{2} y}{d t^{2}}-2 \frac{d y}{d t}+y=t e^{t}
$$

where $y(0)=0, y^{\prime}(0)=3$.
3. (a) The first four moments of a distribution about the value 2.5 are $1,10,20$ and 25 . Obtain first four central moments. Also calculate coefficient of skewness $\left(\beta_{1}\right)$ and coefficient of kurotsis $\left(\beta_{2}\right)$.
(b) A dice is thrown five times. If getting an odd number is a success, then what is the probability of getting :
(i) four successes
(ii) at least four successes.
(c) Find the directional derivative of $\phi=x y^{2}+y z^{2}+z x^{2}$ at (1, 1, 1) along the vector $\bar{i}+2 \bar{j}+2 \bar{k}$.

## Or

4. (a) Obtain the regression line of $y$ on $x$ for the following data :
[4]

| $\boldsymbol{x}$ | $\boldsymbol{y}$ |
| :--- | :--- |
| 1 | 2 |
| 2 | 5 |
| 3 | 3 |
| 4 | 8 |
| 5 | 7 |

(b) Prove the following (any one) :
(i) $\quad \nabla \cdot\left(\frac{\bar{a} \times \bar{r}}{r}\right)=0$
(ii) $\quad \nabla^{2}\left(r^{9} \log r\right)=(90 \log r+19) r^{7}$.
(c) Show that the vector field :

$$
\overline{\mathrm{F}}=\left(x^{2}-y z\right) \bar{i}+\left(y^{2}-z x\right) \bar{j}+\left(z^{2}-x y\right) \bar{k}
$$

is irrotational. Also find the scalar potential $\phi$ such that $\overline{\mathrm{F}}=\nabla \phi$.
5. (a) Evaluate $\int_{\mathrm{C}} \overrightarrow{\mathrm{F}} \cdot d \vec{r}$ where $\overrightarrow{\mathrm{F}}=z i+x j+y k$ and C is the arc of the curve $\vec{r}=\cos t i+\sin t j+t k$ from $\mathrm{t}=0$ to $\mathrm{t}=2 \pi$.
(b) Using Gauss divergence theorem, evaluate $\iiint_{\mathrm{V}} \nabla \cdot \overrightarrow{\mathrm{F}} d \mathrm{~V}$ where $\overrightarrow{\mathrm{F}}=2 x^{2} y i-y^{2} j+4 x z^{2} k$ over the region bounded by the cylinder $y^{2}+z^{2}=9$ and the plane $z=2$ in the first octant. [4]
(c) Using Stoke's theorem evaluate $\iint_{S} \nabla \times \overrightarrow{\mathrm{F}} \cdot \hat{n} d \mathrm{~S}$ where $\overrightarrow{\mathrm{F}}=(x+y) i+(y+z) j-x k$ and S is the surface of the plane $2 x+y+z=2$ which is in the first octant.

## Or

6. (a) Using Green's theorem, evaluate $\int_{\mathrm{C}} e^{-x}(\sin y d x+\cos y d y)$ where 'C' is the rectangle with vertices $(0,0)(\pi, 0),\left(\pi, \frac{\pi}{2}\right),\left(0, \frac{\pi}{2}\right)$.
(b) Using Gauss divergene theorem, evaluate

$$
\iint_{\mathrm{S}}\left[\left(x^{2}-y z\right) d y d z+\left(y^{2}-x z\right) d x d z+\left(z^{2}-x y\right) d x d y\right]
$$

taken over rectangular parallelopiped $0 \leq x \leq a, 0 \leq y \leq$ $b, 0 \leq z \leq c$.
(c) Using stoke's theorem evaluate $\iint_{\mathrm{S}} \nabla \times \overrightarrow{\mathrm{F}} \cdot \hat{n} d \mathrm{~S}$. Where $\overrightarrow{\mathrm{F}}=y i+z j+x k$ over the surface $x^{2}+y^{2}=1-z, z>0$.
7. (a) Solve the wave equation $\frac{\partial^{2} u}{\partial t^{2}}=\mathrm{C}^{2} \frac{\partial^{2} u}{\partial x^{2}}$ under the conditions :
(i) $u(0, t)=0$
(ii) $u(4, t)=0$
(iii) $\frac{\partial u}{\partial t}=0$ when $t=0$
(iv) $u(x, 0)=25$.
(b) Solve $\frac{\partial u}{\partial t}=\mathrm{C}^{2} \frac{\partial^{2} u}{\partial x^{2}}$ under the conditions:
(i) $u(0, t)=0$
(ii) $u(2, t)=0$
(iii) $u(x, 0)=x, 0<x<2$

## Or

8. (a) Solve $\frac{\partial^{2} \mathrm{~V}}{\partial x^{2}}+\frac{\partial^{2} \mathrm{~V}}{\partial y^{2}}=0$, given that :
(i) $\mathrm{V}(0, y)=0$
(ii) $\mathrm{V}(\mathrm{C}, y)=0$
(iii) $\mathrm{V} \rightarrow 0$ as $y \rightarrow \infty$
(iii) $\mathrm{V}=\mathrm{V}_{0}$ when $y=0$.
(b) Use fourier transform to solve the equation

$$
\frac{\partial u}{\partial t}=\frac{\partial^{2} u}{\partial t^{2}}, 0<x<\infty, t>0
$$

subejct to conditions :
(i) $u(0, t)=0, t>0$
(ii) $u(x, 0)=\left\{\begin{array}{lc}6 & 0<x<1 \\ 0 & x>1\end{array}\right.$
(iii) $u(x, t)$ is bounded.

# S.E. (Mechanical/Mechanical Sandwich/Automobile) ELECTRICAL AND ELECTRONICS ENGINEERING (2015 Pattern) 

## Time : 2 Hours]

[Max. Marks : 50
Instructions to the candidates:

1) Answer Q. 1 or Q.2, Q. 3 or Q.4, Q. 5 or Q.6, Q. 7 or Q.8.
2) Neat diagrams must be drawn wherever necessary.
3) Figures to the right indicate full marks.
4) Use of electronic pocket calculator is allowed.
5) Assume suitable data, if necessary.

Q1) a) Draw the schematic of three point starter used for DC shunt motor. Indicate following components of three point starter and write their functions during operation.
i) No - Volt Coil
ii) Overload release
b) The power input to a three phase induction motor is 40 KW . The stator losses are 1 KW and the friction and windage losses are 2 KW . If the motor operates at slip of $4 \%$, find
i) Mechanical power developed
ii) Rotor copper loss per phase and
iii) Efficiency of motor

OR
Q2) a) Explain the operation of star - delta starter used for three phase induction motor with the help of neat schematic.
b) A 250 V DC shunt motor has armature resistance of $0.25 \Omega$. It takes an armature current of 50 A on certain load while running at 750 rpm . If the flux of the motor is reduced by $10 \%$ without charging the load torque, find the new speed of the motor.

Q3) a) Describe construction and working of Universal motor with the help of suitable diagrams and state its any two applications in practice.
b) State any six features of Arduino IDE.

## OR

Q4) a) Describe construction and working of shaded pole Induction motor with the help of suitable sketches and state its any two applications in practice.
b) Draw the block diagram of Data Acquisition system and briefly explain the function of each block.
[6]

Q5) a) Explain the following functions along with their syntax.
i) Serial. print ()
ii) Serial . print $\ln ()$
iii) Serial. read ()
b) Draw a neat sketch showing the interfacing of Atmega 328P based Arduino board with $16 \times 2$ Liquid crystal display (LCD) and write algorithmic steps to continuously blink the message written on the display on two rows with a delay of 1 second.

Q6) a) Explain the following functions used to handle GPIO in ATmega 328P based Arduino board with the help of syntax.
i) Pin Mode ( )
ii) Digital Read ()
iii) Digital Write ()
b) It is desired to blink three LEDs simultaneously for ON/OFF period of 10 msec . The LEDs are connected to digital pins 3,5 and 7 of port B of ATmega 328P based Arduino board. Draw the interfacing diagram and write the algorithmic steps to execute program.

Q7) a) Explain the principle of operation of LVDT and draw the interfacing diagram of LVDT with Arduino board.
b) Explain the following characteristics of analog to digital converters (ADC) briefly and specify these in case of ADC in ATmega 328P based Arduino board.
i) Resolution
ii) Absolute accuracy
iii) Conversion time
iv) Data rate

> OR

Q8) a) Explain the concept of Pulse Width modulation (PWM). Draw the interfacing circuit showing DC motor interface with Arduino.
b) What is LM 35? How can LM 35 be interfaced with ATmega 328P based Arduino board? Draw relevant interfacing diagram.

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